Germ Plasm Evaluation Program

Progress Report No. 7

Roman L. Hruska
U.S. Meat Animal Research Center

In cooperation with
Kansas State University
and the University of Nebraska

Agricultural Reviews and Manuals
Science and Education Administration
U.S. Department of Agriculture

ARM-NC-6

July 1979

* * * * * * * * * * * * * * * * * * *

The cattle Germ Plasm Evaluation Program at the Roman L. Hruska U.S. Meat Animal Research Center is designed to characterize different biological types represented by breeds varying widely in characteristics such as milk production, growth, mature size and carcass composition. A major objective is to characterize breeds representing different biological types in different feed environments and production situations for the full spectrum of biological traits relating to economic beef production.

A coordinated research effort is employed involving scientists from the disciplines of animal breeding, reproductive physiology, nutrition, meats, and management systems. The program was initiated in 1969. Progress reports have been published annually summarizing current results from each cycle and phase of the program for traits of principal economic importance to the beef cattle industry.

* * * * * * * * * * * * * * * * * * *

CATTLE GERM PLASM EVALUATION PROGRAM[1]

PROGRESS REPORT NO. 7

ROMAN L. HRUSKA U.S. MEAT ANIMAL RESEARCH CENTER

The cattle Germ Plasm Evaluation Program has been conducted in three cycles. Cycle I involved breeding Hereford, Angus, Jersey, South Devon, Limousin, Simmental and Charolais bulls by artificial insemination (AI) to Hereford and Angus cows to produce three calf crops (Cycle I, Phase 2) in the spring of 1970, 1971 and 1972.

Cycle II, initiated with the 1972 breeding season, involved the Hereford and Angus cows used in the first cycle. These cows were bred by AI to Hereford, Angus, Red Poll, Brown Swiss, Gelbvieh, Maine Anjou and Chianina sires to produce two calf crops (Cycle II, Phase 2) in the spring of 1973 and 1974. In addition, in Cycle II, Phase 2, Red Poll and Brown Swiss cows were added to the program and mated to Hereford, Angus, Red Poll and Brown Swiss sires to provide for a four-breed diallel crossbreeding experiment.

Cycle III was initiated during the 1974 breeding season. In Cycle III, the Hereford and Angus cows used to initiate Cycles I and II were mated by AI to Hereford, Angus, Pinzgauer, Tarentaise, Brahman, and Sahiwal sires to produce two calf crops (Cycle III, Phase 2) in the spring of 1975 and 1976.

Fifteen of the Hereford and 16 of the Angus sires used in Cycle I were also used in Cycle II and Cycle III to insure a stable control population of Hereford and Angus reciprocal crosses that are used as a basis for comparison between different cycles and phases of the program. Within each cycle of sire breeds, foundation cows (Hereford and Angus, in Cycles I, II and III, plus Red Poll and Brown Swiss in Cycle II) are referred to as Phase 1. Their calves are called Phase 2, and the calves from Phase 2 cows are designated Phase 3. Specific mating plans for each cycle and phase of the program are provided in the appendix.

Previous progress reports have presented completed data for Cycles I, II and III and are available by request. Progress Report No. 1 (ARS-NC-13, 1974) included birth and weaning traits of Cycle I, Phase 2, calves and postweaning growth, feed efficiency and carcass and meat traits of the steers. Progress Report No. 2 (ARS-NC-22, 1975) included the growth, reproduction and maternal performance of Cycle I, Phase 2, females through 2 years of age and, for Cycle II, Phase 2, the preweaning traits for both calf crops and the steer postweaning traits for the 1973 calf crop. Progress Report No. 3 (ARS-NC-41, 1976) presented a complete summary and discussion of Cycle I, Phase 2, results

---

[1]Roman L. Hruska U.S. Meat Animal Research Center, Agricultural Research, Science and Education Administration, U.S. Department of Agriculture, Clay Center, Nebr. 68933; Standardization Branch, Meat Quality Division, Food Safety and Quality Service, U.S. Department of Agriculture; Kansas State University, Manhattan; and the University of Nebraska, Lincoln, cooperating.

from birth through slaughter for steers and from birth through puberty for the heifers. Progress Report No. 4 (ARS-NC-48, 1976) included reproduction and maternal performance of Cycle I, Phase 2, cows as 3-year-olds, preweaning and postweaning information for Cycle I, Phase 3, calves, and postweaning steer data for the 1974 calf crop and postweaning heifer data for both calf crops of Cycle II, Phase 2, calves. For results on calving, reproduction and maternal performance of Cycle I, Phase 3, and Cycle II, Phase 2, cows as 2-year-olds, readers are referred to Progress Report No. 5 (ARS-NC-55, 1977). Progress Report No. 5 also included complete results for birth and weaning traits on Cycle III, Phase 2, calves. Progress Report No. 6 (ARM-NC-2, 1978) included postweaning growth, and carcass data of steers and growth, puberty and conception data of heifers in Cycle II, Phase 3 and Cycle III, Phase 2.

This report provides reproduction and maternal performance data for Cycle I, Phase 2, cows as 4-, 5-, 6-, 7- and 8-year-olds; Cycle II, Phase 2, cows as 3-, 4- and 5-year olds; Cycle II, Phase 3, cows as 2-year-olds and Cycle III, Phase 2 cows as 2-year-olds and 3-year-olds.

General releases of information on individual sires are not planned because erroneous conclusions may be drawn from the ranking of individual sires with the relatively small number of progeny per sire in this program. The objective of the program is to characterize breeds as representatives of different biological types. To do this effectively, a large sample of sires of each breed is necessary. Thus, the number of progeny per sire is generally low. A relatively large number of progeny per sire are required for a high level of accuracy in ranking individual sires on their breeding value for most economic traits.

CYCLE I, PHASE 2

Foundation Cows. The foundation Hereford and Angus cows used in the program were purchased as calves at weaning from commercial producers in Nebraska. The cows were 2 through 5 years of age, 2 through 6 years of age, and 3 through 7 years of age at calving in 1970, 1971 and 1972, respectively.

Sires. In Cycle I, 32 Hereford, 35 Angus, 33 Jersey, 28 South Devon, 20 Limousin, 28 Simmental and 26 Charolais bulls were used during the 1969, 1970 and 1971 breeding seasons. The Hereford and Angus bulls used in this program were sampled from bulls that had been selected on individual performance information, which was the basis for entering into the progeny testing programs of commercial artificial insemination organizations. The Jersey bulls were selected at random from two commercial AI organizations, and the South Devon bulls were sampled from an importation made in 1969 by a commercial organization. Simmental, Limousin and Charolais bulls were sampled from bulls available from commercial AI organizations and from the Canada Department of Agriculture for the Simmental and Limousin.

For a cooperative study with the Canada Department of Agriculture, Hereford x Angus, Jersey x Angus, Simmental x Angus and Charolais x Angus heifers were randomly selected at weaning time and shipped, 4 to 8 weeks after weaning, to the Research Station, Lethbridge, Alberta. There were 12 heifers

per breed group in 1970 and 10 heifers per breed group in 1971 and 1972. These females and their offspring were individually fed to evaluate efficiency of production.

Matings. Cycle I, Phase 2, yearling heifers were mated to Hereford, Angus, Brahman, Devon and Holstein bulls during a 45- to 46-day AI season and to Hereford and Angus bulls for a 21- to 24-day cleanup period in 1971, 1972 and 1973 (appendix table 3). As 2-year-old cows, they were mated to Hereford, Angus, Chianina, Gelbvieh and Maine Anjou bulls for a 42- to 45-day AI season and to Hereford and Angus bulls during a 22-day cleanup in 1972, 1973 and 1974. As 3-year-olds and above, the cows are being mated by natural service to Brown Swiss (predominantly European) bulls for 63 days.

Data Analysis. Calving difficulty, calf mortality, calf birth weight and preweaning growth were analyzed by least-squares procedures for unequal subclass numbers using a model that included the effects of breed of cow's sire, breed of cow's dam, cow age-year, sex and two-way interactions. Birth and 200-day weight and preweaning growth rate were adjusted to a steer basis by adjustment factors calculated from the data and shown in the table footnotes. Calf crop percentage, pregnancy rate, cow weights and heights were analyzed with a similar least-squares procedure except that sex and two-way interactions with sex were not included in the model.

Calving Difficulty. Calving difficulty scores were assigned to each calf at birth on the basis of the following system:

Score		
1	No difficulty	- Calves unassisted.
2	Little difficulty	- Assistance given by hand, but no jack or puller used; assistance actually may not have been required.
3	Moderate difficulty	- Assistance given with jack or calf-puller; some difficulty was encountered even with the puller being used.
4	Major difficulty	- Calf jack used and major difficulty encountered usually 30 minutes or more required to deliver calf.
5	Caesarean birth	- Performed after determination made that calf could not be delivered with a calf-puller.
6	Abnormal presentation	- Assistance given: posterior, head back, leg back, and so forth.

Summaries of calving difficulty in 4-, 5-, 6-, 7- and 8-year-old cows are provided in table 1. For these summaries, scores of 1 and 2 were combined and are designated no difficulty and scores of 3 and 4 were combined and are designated calf-puller.

Reproductive and Maternal Performance. Information is presented on rebreeding performance of 4-, 5-, 6-, 7- and 8-year-olds in table 2. Least squares means for cow weight at fall palpation time and fall hip height measurements when cows were 6½-, 7½- and 8½-years of age are also included in table 2. Preweaning growth and calf crop percentages are provided in table 1 for calves from these same cows.

CYCLE II, PHASE 2

Cows. The foundation Hereford and Angus cows used in Cycle I were continued in Cycle II of the program. The cows calving in 1973 were 4 to 8 years of age and in 1974 were 4 to 9 years of age. As previously indicated, mature Brown Swiss and Red Poll cows were added to these herds for the 1972 and 1973 breeding season.

Sires. In Cycle II, 15 Hereford, 16 Angus, 16 Red Poll, 11 Brown Swiss, 11 Gelbvieh, 18 Maine Anjou and 20 Chianina bulls were used during the 1972 and 1973 breeding seasons. The Hereford and Angus sires had also been used in Cycle I of the program, and the other bulls were sampled from commercial organizations. The Brown Swiss sires included four domestic bulls and seven bulls imported into Canada from Switzerland and Germany.

Birth, Preweaning and Postweaning Data. Data on calving difficulty and preweaning growth for both calf crops produced (1973-74) and postweaning growth, feed efficiency and carcass and meat traits for the first calf crop of Cycle II, Phase 2, were summarized previously (ARS-NC-22, Progres Report No. 2, 1975). In addition, steer postweaning data from the second calf crop, and heifer postweaning growth, puberty and conception for both calf crops were reported previously (ARS-NC-48, Progress Report No. 4, 1976). Data on calving difficulty, reproduction, maternal performance and size of 2-year-olds were presented in Progress Report No. 5 (ARS-NC-55, 1977).

Calving and Rebreeding of 3- and 4-Year-Olds. Data on calving difficulty, calf crop percentage and birth and weaning weights of calves from 3-, 4- and 5-year-old dams (born in 1973-74) are presented in table 3 for cows out of Hereford and Angus dams. Data on rebreeding performance and size as 3-, 4-, and 5-year-olds are given in table 4. The cows were bred as 2-, 3- and 4-year-olds by natural sevice to 3/4 Simmental bulls.

Calving difficulty, calf mortality, calf birth weight and preweaning growth were analyzed by least-squares procedures for unequal subclass numbers using a model that included the effects of breed of dam's sire, breed of dam's dam, year-age of cow, sex of calf and two-way interactions. Birth and 200-day weight and preweaning growth rate were adjusted to a steer basis by adjustment factors calculated from the data and shown in table footnotes. Calf crop percentage, pregnancy rate, cow weights and cow heights were analyzed by similar least-squares procedures except that sex and interactions with sex were not included in the model.

CYCLE II, PHASE 3

Sires. The mating plans to produce Cycle II, Phase 3, calves are presented in appendix table 4. There were 13 Hereford, 14 Angus, 13 Santa Gertrudis and 14 Brangus sires used by AI to produce the two calf crops (1975-76). These sires were sampled from commercial organizations, with the Hereford and Angus sires being the same as used in other cycles and phases of the program. Calves resulting from cleanup matings to Hereford and Angus sires were also included in this summary. Calving difficulty, calf survival and preweaning growth were presented in Progress Report No. 5 (ARS-NC-55, 1977). Postweaning growth and carcass data on steers and postweaning growth, puberty and conception data on heifers were summarized in Progress Report No. 6 (ARM-NC-2, 1978).

Calving and Rebreeding of 2-Year-Olds. Data on calving difficulty, calf crop percentage and birth and weaning weights of calves from 2-year-old dams (born in 1975-76) are presented in table 5 according to breed of cows sire. Data for corresponding breed groups on rebreeding performance and size as 2-year-olds are given in table 6.

Calving difficulty, calf mortality, calf birth weight and preweaning growth were analyzed by least-squares procedures for unequal subclass numbers using a model that included the effects of breed of dam's sire, breed of dam's dam, breed of sire, year, sex and two-way interactions. Birth and 200-day weight and preweaning growth rate were adjusted to a steer basis by adjustment factors calculated from the data and shown in table footnotes. Calf crop percentage, pregnancy rate, cow weight and cow height were analyzed by similar least-squares procedures except that sex and interactions with sex were deleted from the model.

CYCLE III, PHASE 2

Cows. The foundation Hereford and Angus cows used to produce Phase 2 calves in Cycles I and II were continued in Cycle III of the program (appendix table 5). The two calf crops in Cycle III, Phase 2, were produced in 1975 and 1976.

Sires. There were 13 Hereford, 14 Angus, 17 Brahman, 6 Sahiwal, 9 Pinzgauer and 7 Tarentaise sires used during the 1974 and 1975 breeding seasons. The Hereford and Angus bulls had also been used in Cycle I and Cycle II of the program, and the Brahman bulls were sampled from commercial AI organizations or purebred Brahman herds. Semen was available from only two Sahiwal bulls (imported from Australia) and one Tarentaise bull for the 1974 breeding season. Semen was available on four additional Sahiwal bulls and six additional Tarentaise bulls for the 1975 breeding season to produce the Cycle III, Phase 2, calf crop in 1976.

A sample of about 32 heifers from each of the Angus-Hereford, Hereford-Angus, Brahman-Hereford, Brahman-Angus, Sahiwal-Hereford, Sahiwal-Angus, Pinzgauer-Hereford and Pinzgauer-Angus breed groups were transferred to the U.S. Department of Agriculture station at Brooksville, Fla., for an interregional study cooperative with the Florida Agricultural Experiment Station to evaluate

genotype-environment interactions involving maternal traits. These heifers and those remaining at the Roman L. Hruska U.S. Meat Animal Research Center are being mated by natural service to bulls sampled from the same population of Red Poll (for first calf crop) and 7/8 Simmental (second through fourth calf crops) to evaluate reproduction and maternal performance in each environment. Calving traits and preweaning growth data for all calves born in 1975 and 1976 were presented in Progress Report No. 5 (ARS-NC-55, 1977). Postweaning growth, feed efficiency and carcass traits of steers and postweaning growth, puberty and conception of yearling heifers were presented in Progress Report No. 6 (ARM-NC-2, 1978).

Reproduction and Maternal Performance. Data on calving difficulty, percentage calf crop and birth and weaning weight of progeny from 2-year-old Cycle III, Phase 2, females (born in 1975 and 1976) are presented in table 7. Data on rebreeding performance and size as 2-year-olds are given for the corresponding breed group in table 8. The Cycle III, Phase 2, females were bred as yearlings by natural service to Red Poll sires. These data were analyzed by least-squares procedures using a model that included effects of breed of sire, breed of dam, year and their two-way interactions. Sex of calf and two way interactions with sex were deleted from models for calf crop percentage, rebreeding performance and cow size.

Data on calving difficulty, percentage calf crop and birth and weaning weight of progeny from 3-year-old Cycle III, Phase 2, females (born in 1975) are presented in table 9. Data on rebreeding performance and size as 3-year-olds are given for the corresponding breed group in table 10. The Cycle III, Phase 2, females were bred as 2- and 3-year-olds to 7/8 Simmental sires. The calving and rebreeding data as 3-year-olds on the 1976 heifers born in Cycle III, Phase 2, are not yet available. Thus, the data presented in tables 11 and 12 are preliminary, representing that from only the first of two calf crops that will be obtained on females calving as 3-year-olds. These data were analyzed by least-squares procedures using a model that included effects of sire-dam breed groups. Effects of sex of calf and sex-breed group interaction were also included in models for calving difficulty and birth and weaning weight of progeny.

TABLE 1. ROMAN L. HRUSKA U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM
CALVING DIFFICULTY, CALF CROP PERCENTAGE, CALF MORTALITY, BIRTH WEIGHT, WEANING WEIGHT
AND WEANING WEIGHT RATIO OF CALVES FROM 4-, 5-, 6-, 7- AND 8-YEAR OLD COWS[a]
CYCLE I, PHASE 2 - COWS BORN 1970-71-72

Breed of Cow		No.	Type of Parturition, %				Calf Crop, %[c]		Calf Mortality, %[d]		Calf Wt, lb[e]		
Sire	Dam	Calves Born	No. Diff.[b]	Calf-Puller	C-Section	Abn. Presentation	Born	Weaned	Early	Late	Birth	200-Day	200-Day Wt Ratio[f]
Angus	Hereford	224	97.0	0.5	0.0	2.5	95.8	87.7	2.5	5.3	91.3	507	101.2
Hereford	Angus	237	95.5	3.1	0.4	1.0	95.6	89.8	4.0	1.1	91.6	495	98.8
	Average	461	96.3	1.8	0.2	1.7	95.7	88.7	3.3	3.2	91.4	501	100.0
Jersey	Hereford	217	98.9	1.0	0.0	0.1	96.8	92.9	3.0	1.3	85.6	516	103.0
	Angus	161	98.0	0.6	0.0	1.4	89.5	82.4	4.1	3.8	81.1	509	101.6
	Average	378	98.5	0.8	0.0	0.7	93.1	87.6	3.5	2.5	83.4	512	102.2
South Devon	Hereford	184	93.5	2.3	0.6	3.6	93.3	90.5	1.2	1.7	98.1	520	103.8
	Angus	166	93.8	3.0	0.0	3.2	92.9	90.9	1.6	1.1	92.7	517	103.2
	Average	350	93.7	2.7	0.3	3.4	93.1	90.7	1.4	1.4	95.4	519	103.6
Limousin	Hereford	259	96.1	2.2	0.1	1.6	93.6	84.7	6.1	2.0	94.5	515	102.8
	Angus	269	93.7	2.6	0.4	3.2	97.9	89.3	6.8	0.7	89.9	505	100.8
	Average	528	94.9	2.4	0.3	2.4	95.8	87.0	6.4	1.4	92.2	510	101.8
Simmental	Hereford	296	91.1	6.1	0.3	2.4	94.7	88.2	5.9	1.1	97.8	551	110.0
	Angus	238	93.1	3.7	0.0	3.2	92.5	84.8	6.4	2.0	94.5	547	109.2
	Average	534	92.1	4.9	0.2	2.8	93.6	86.5	6.1	1.6	96.1	549	109.6
Charolais	Hereford	263	90.2	4.4	1.6	3.8	94.8	85.5	6.6	3.3	97.9	532	106.2
	Angus	164	92.6	3.0	0.1	4.3	93.4	85.0	6.5	1.6	97.6	531	106.0
	Average	427	91.4	3.7	0.8	4.1	94.1	85.3	6.6	2.4	97.7	531	106.0
Average	Hereford	1443	94.5	2.8	0.4	2.3	94.8	88.3	4.2	2.5	94.2	524	104.6
All Sire	Angus	1235	94.5	2.7	0.2	2.7	93.6	87.0	4.9	1.7	91.2	517	103.2
Breeds	Average	2678	94.5	2.7	0.3	2.5	94.2	87.6	4.6	2.1	92.7	520	103.8

[a] Calves from these cows were sired by Brown Swiss bulls (appendix table 3).

[b] No assistance or minor hand assistance.

[c] Of cows alive at calving; cows removed from experiment only for serious injury, being open two successive years or by death.

[d] Early mortality is within 72 hr of birth; late is from 72 hr after birth until weaning.

[e] Adjusted to a steer basis. Least-squares adjustment factors for heifers were 6.5 lb for birth weight and 34 lb for 200-day weight.

[f] Ratio computed relative to 501 lb average for Hereford and Angus sired dams.

TABLE 2. ROMAN L. HRUSKA U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM
CALVING DATE, REBREEDING PERFORMANCE AND SIZE OF COWS CALVING AS 6-, 7- AND 8-YEAR OLD COWS
CYCLE I, PHASE 2 - COWS BORN 1970-71-72

Breed of Cow		No. Cows			Avg.		Cow Weight, lb			Hip Height, in		
Sire	Dam	6-Yr. Olds	7-Yr. Olds	8-Yr. Olds	Calving Date[a]	Percent Preg.[b]	6½ Years	7½ Years	8½ Years	6½ Years	7½ Years	8½ Years
Angus	Hereford	56	38	17	April 1	94.4	1172	1202	1161	47.8	48.4	48.4
Hereford	Angus	59	43	22	April 5	96.1	1167	1233	1203	48.3	48.6	48.5
	Average	115	81	39	April 3	95.2	1169	1217	1182	48.0	48.5	48.4
Jersey	Hereford	51	46	23	March 29	97.9	1009	1060	1047	48.6	48.6	48.5
	Angus	45	26	12	March 29	92.6	1026	1041	1015	48.0	47.8	47.3
	Average	96	72	35	March 29	95.2	1018	1051	1031	48.3	48.2	47.9
South Devon	Hereford	50	25	10	April 6	93.4	1234	1247	1279	50.5	50.5	50.3
	Angus	41	32	13	April 1	93.8	1199	1244	1234	50.2	50.2	50.4
	Average	91	57	23	April 4	93.6	1217	1245	1256	50.4	50.3	50.3
Limousin	Hereford	70	37	25	April 5	94.9	1203	1234	1244	50.7	50.6	50.1
	Angus	67	45	23	April 1	96.5	1183	1218	1226	50.1	49.9	49.5
	Average	137	82	48	April 3	95.7	1193	1226	1235	50.4	50.2	49.8
Simmental	Hereford	78	50	20	April 6	95.4	1231	1271	1289	51.2	51.4	51.3
	Angus	63	46	20	April 2	93.5	1214	1277	1228	50.5	50.4	50.4
	Average	141	96	40	April 4	94.4	1223	1274	1259	50.9	50.9	50.8
Charolais	Hereford	65	44	27	April 5	95.4	1296	1357	1312	51.1	51.1	50.6
	Angus	45	24	12	April 5	92.8	1286	1333	1348	50.8	50.9	50.4
	Average	110	68	39	April 5	94.1	1291	1345	1330	51.0	51.0	50.5
Average	Hereford	370	240	122	April 4	95.2	1191	1229	1222	50.0	50.1	49.9
All Sire	Angus	320	216	102	April 2	94.2	1179	1224	1209	49.7	49.6	49.4
Breeds	Average	690	456	224	April 3	94.7	1185	1226	1216	49.8	49.9	49.6

[a] Includes cows calving at 4-, 5-, 6-, 7- and 8-years of age.

[b] Breeding period was 63 days by natural service to Brown Swiss bulls (appendix table 3). Percent pregnant = no. palpated as pregnant ÷ no. palpated, and only includes cows that calved prior to breeding.

TABLE 3. ROMAN L. HRUSKA U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM
CALVING DIFFICULTY, CALF CROP PERCENTAGE, CALF MORTALITY, BIRTH WEIGHT, WEANING WEIGHT
AND WEANING WEIGHT RATIO OF CALVES FROM 3-, 4- AND 5-YEAR-OLD COWS[a]
CYCLE II, PHASE 2 - COWS BORN 1973-74

Breed of Cow		No.	Type of Parturition, %				Calf Crop, %[c]		Calf Mortality, %[d]		Calf Wt, lb.[e]		
Sire	Dam	Calves Born	No Diff.[b]	Calf-Puller	C-Section	Abn. Presentation	Born	Weaned	Early	Late	Birth	200-Day	200-Day Wt Ratio[f]
Angus	Hereford	80	92.1	4.0	0.0	3.9	88.7	84.1	3.8	2.2	86.9	475	100.6
Hereford	Angus	113	81.8	16.5	0.0	1.8	96.2	92.1	1.3	2.1	88.0	470	99.6
	Average	193	86.9	10.2	0.0	2.8	92.5	88.1	2.6	2.1	87.4	472	100.0
Red Poll	Hereford	81	83.3	14.3	0.0	2.5	92.0	85.9	4.3	2.2	92.1	501	106.1
	Angus	105	91.6	3.1	0.1	5.2	88.9	79.1	8.7	1.3	86.3	487	103.2
	Average	186	87.5	8.7	0.0	3.9	90.5	82.5	6.5	1.7	89.2	494	104.7
Brown Swiss	Hereford	141	82.2	12.2	0.7	4.8	92.0	88.1	4.0	0.8	95.4	533	112.9
	Angus	142	95.2	3.7	0.0	1.2	97.3	93.1	3.4	1.4	90.2	529	112.1
	Average	283	88.7	8.0	0.4	3.0	94.6	90.6	3.7	1.1	92.8	531	112.5
Gelbvieh	Hereford	93	86.7	10.5	0.2	2.7	96.6	89.0	3.5	2.1	94.0	533	112.9
	Angus	101	94.0	3.8	0.9	1.3	97.0	89.2	7.0	1.0	87.6	523	110.8
	Average	194	90.3	7.1	0.5	2.0	96.8	89.1	5.2	1.5	90.8	528	111.9
Maine Anjou	Hereford	91	90.2	7.6	0.0	2.1	94.1	86.9	4.2	3.4	99.4	524	111.0
	Angus	108	88.2	9.0	0.1	2.7	94.2	89.5	2.7	1.8	96.6	509	107.8
	Average	199	89.2	8.3	0.0	2.4	94.1	88.2	3.4	2.6	98.0	517	109.5
Chianina	Hereford	93	95.4	2.8	0.8	1.0	95.4	90.5	1.1	4.1	100.1	523	110.8
	Angus	100	95.0	4.6	0.7	0.0	95.6	90.8	3.7	0.6	95.2	515	109.1
	Average	193	95.2	3.7	0.8	0.3	95.5	90.6	2.4	2.4	97.6	519	110.0
Average	Hereford	579	88.3	8.6	0.3	2.8	93.2	87.4	3.5	2.5	94.7	515	109.1
All Sire	Angus	669	91.0	6.8	0.3	2.0	94.9	89.0	4.5	1.4	90.7	506	107.2
Breeds	Average	1248	89.6	7.7	0.3	2.4	94.0	88.2	4.0	1.9	92.7	510	108.1

[a] Calves from these cows were sired by 3/4 Simmental bulls (appendix table 4).

[b] No assistance or minor hand assistance.

[c] Of cows alive at calving; cows removed from experiment only for serious injury, being open two successive years or by death.

[d] Early mortality is within 72 hr of birth; late is from 72 hr after birth until weaning.

[e] Adjusted to a steer basis. Least-squares adjustment factors for heifers were 6.6 lb for birth weight and 31 lb for 200-day weight.

[f] Ratio computed relative to 472 lb average for Hereford and Angus sired dams.

TABLE 4. ROMAN L. HRUSKA U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM
CALVING DATE, REBREEDING PERFORMANCE AND SIZE OF COWS CALVING AS 3-, 4- AND 5-YEAR-OLD COWS
CYCLE II, PHASE 2 - COWS BORN 1973-74

Breed of Cow		No. Cows			Avg.		Cow Weight, lb			Cow Hip Height, in		
Sire	Dam	3-Yr. Olds	4-Yr. Olds	5-Yr. Olds	Calving Date	Percent Preg.[a]	3½ Years	4½ Years	5½ Years	3½ Years	4½ Years	5½ Years
Angus	Hereford	33	34	15	March 29	90.2	1050	1147	1143	47.7	48.3	49.0
Hereford	Angus	47	48	20	April 1	95.3	991	1081	1115	47.0	47.6	48.3
	Average	80	82	35	March 31	92.7	1021	1114	1129	47.4	47.9	48.7
Red Poll	Hereford	35	38	11	March 30	91.1	987	1073	1044	48.3	48.6	48.3
	Angus	46	49	17	March 30	89.7	967	1068	1091	48.0	48.1	48.3
	Average	81	87	28	March 30	90.4	977	1071	1067	48.1	48.3	48.3
Brown Swiss	Hereford	58	63	24	March 31	97.2	1034	1125	1147	49.9	50.3	51.0
	Angus	60	60	21	March 30	96.3	1021	1098	1106	49.3	50.0	50.2
	Average	118	123	45	March 31	96.7	1028	1112	1127	49.6	50.1	50.6
Gelbvieh	Hereford	37	35	19	April 3	97.6	1059	1165	1197	50.1	50.7	51.0
	Angus	41	40	22	March 31	95.1	1051	1156	1154	49.4	49.9	49.9
	Average	78	75	41	April 1	96.4	1055	1161	1175	49.7	50.3	50.4
Maine Anjou	Hereford	35	38	21	March 30	94.6	1121	1225	1297	50.6	51.1	51.7
	Angus	44	48	18	March 29	94.3	1119	1221	1264	49.9	50.4	50.5
	Average	79	86	39	March 30	94.5	1120	1223	1280	50.2	50.7	51.1
Chianina	Hereford	38	42	14	April 3	93.5	1143	1242	1295	54.0	54.4	55.2
	Angus	42	43	16	April 1	95.4	1132	1236	1252	53.2	53.5	54.0
	Average	80	85	30	April 2	94.4	1138	1239	1273	53.6	53.9	54.6
Average	Hereford	236	250	104	March 31	94.0	1066	1163	1187	50.1	50.6	51.0
All Sire	Angus	280	288	114	March 31	94.4	1047	1143	1164	49.5	49.9	50.2
Breeds	Average	516	538	218	March 31	94.2	1056	1153	1175	49.8	50.2	50.6

[a] Breeding period was 63 days by natural service to 3/4 Simmental bulls (appendix table 4). Percent pregnant = no. palpated as pregnant ÷ no. palpated, and only include cows that calved prior to breeding.

TABLE 5. ROMAN L. HRUSKA U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM
CALVING DIFFICULTY, CALF CROP PERCENTAGE, CALF MORTALITY, BIRTH WEIGHT, WEANING WEIGHT AND WEANING WEIGHT RATIO OF CALVES FROM 2-YEAR-OLD COWS[a]
CYCLE II, PHASE 3, - COWS BORN IN 1975-76

Breed of Dam of Heifer		No.	Type of Parturition, %				Calf Crop, %[c]		Calf Mortality, %[d]		Calf Wt., lb.[e]		
Sire	Dam	Calves Born	No Diff.[b]	Calf-Puller	C-Section	Abn. Presentation	Born	Weaned	Early	Late	Birth	200-Day	200-Day Wt. Ratio[f]
Angus	Hereford	11	51.1	26.8	14.2	7.9	96.4	92.7	1.9	1.1	74.5	443	98.9
Hereford	Angus	11	46.6	47.5	0.0	10.4	95.5	67.2	32.6	0.0	73.2	453	101.1
	Average	22	48.9	37.1	4.8	9.2	95.9	79.9	17.3	0.7	73.8	448	100.0
Red Poll	Hereford	15	77.6	22.5	3.9	0.0	92.4	83.4	7.9	1.1	75.6	435	97.1
	Angus	13	85.7	11.8	6.3	0.0	79.8	64.5	13.2	6.4	79.7	491	109.6
	Average	28	81.7	17.2	5.1	0.0	86.1	74.0	10.5	3.7	77.7	463	103.3
Brown Swiss	Hereford	17	80.4	15.4	3.0	1.2	90.0	72.5	19.6	0.0	73.9	478	106.7
	Angus	13	0.0	54.6	14.6	34.7	88.5	66.8	20.1	7.5	81.8	485	108.3
	Average	30	38.2	35.0	8.8	18.0	89.2	69.6	19.8	2.9	77.8	481	107.4
Gelbvieh	Hereford	12	36.2	46.9	0.3	16.6	92.4	85.5	5.2	1.7	83.3	487	108.7
	Angus	14	57.4	29.2	16.6	0.0	95.2	87.1	9.1	0.0	80.2	450	100.4
	Average	26	46.8	38.1	8.4	6.7	93.8	86.3	7.1	0.8	81.8	469	104.7
Maine Anjou	Hereford	15	66.1	29.8	4.9	0.0	82.5	67.5	1.9	11.1	74.3	453	101.1
	Angus	13	41.9	52.7	4.0	1.5	96.0	75.7	12.8	8.1	76.6	441	98.4
	Average	28	54.0	41.2	4.4	.4	89.3	71.6	7.4	9.6	75.4	447	99.8
Chianina	Hereford	17	80.5	21.4	0.4	0.0	105.8	101.8	2.3	1.5	77.8	456	101.8
	Angus	19	51.7	41.4	1.8	5.1	95.4	84.1	9.6	0.0	80.3	460	104.5
	Average	36	66.1	31.4	1.1	1.4	100.6	92.9	5.9	0.8	79.1	458	102.2
Average	Hereford	87	65.3	27.1	4.5	3.1	93.3	83.9	6.4	5.4	80.5	459	102.5
All Sire	Angus	83	46.5	39.5	6.5	7.5	91.7	74.2	16.2	0.3	74.7	463	103.3
Breeds	Average	170	55.9	33.3	5.5	5.3	92.5	79.1	11.3	2.9	77.6	461	102.9

[a] Calves from these cows were sired by Shorthorn bulls.
[b] No assistance or minor hand assistance.
[c] Of cows alive at calving; cows removed from experiment only for serious injury, being open two successive years or by death.
[d] Early mortaltiy is within 72 hr. of birth; late is from 72 hr. after birth until weaning.
[e] Adjusted to a steer basis. Least-squares adjustment factors for heifers were 5.9 for birth weight and 28 lb. for 200-day weight.
[f] Ratio computed relative to 448 lb. average for Hereford and Angus sired dams.

TABLE 6. ROMAN L. HRUSKA U.S. MEAT ANIMAL REEARCH CENTER GERM PLASM EVALUATION PROGRAM
CALVING DATE, REBREEDING PERFORMANCE AND SIZE OF COWS CALVING AS 2-YEAR-OLDS
CYCLE II, PHASE 3 - COWS BORN IN 1975-76

Breed of Cow		No. Calving as 2-Year Olds	Avg. Calving Date	Percent Preg.[a]	Cow Weight, lb 2½ Years	Condition Score[b] 2½ Years
Sire	Dam					
Angus	Hereford	11	March 19	81.5	979	6.3
Hereford	Angus	11	March 15	85.0	959	6.8
	Average	22	March 12	83.3	969	6.6
Red Poll	Hereford	15	March 10	89.6	959	6.4
	Angus	13	March 16	86.0	994	6.2
	Average	28	March 13	87.8	976	6.3
Brown Swiss	Hereford	17	March 10	90.4	1007	6.5
	Angus	13	March 14	76.5	1024	6.0
	Average	30	March 12	83.5	1015	6.3
Gelbvieh	Hereford	12	March 17	94.7	1046	6.1
	Angus	14	March 21	87.4	1024	6.2
	Average	26	March 19	91.1	1035	6.1
Maine Anjou	Hereford	15	March 8	94.7	1053	6.0
	Angus	13	March 12	97.8	1046	6.6
	Average	28	March 10	96.2	1049	6.3
Chianina	Hereford	17	March 17	97.0	1044	6.0
	Angus	19	March 11	95.0	1050	5.9
	Average	36	March 14	96.0	1047	5.9
Average All Sire Breeds	Hereford	87	March 12	91.3	1015	6.2
	Angus	83	March 15	87.9	1016	6.3
	Average	170	March 14	89.6	1016	6.3

[a] Breeding period was 63 days by natural service to 7/8 Simmental bulls. Percent pregnant = no. palpated as pregnant ÷ no. palpated, and only includes cows that calved prior to breeding.
[b] Condition is scored on a scale of 1 to 9; 1 = thin, emaciated; 5 = average; 9 = very fat

TABLE 7. ROMAN L. HRUSKA U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM
CALVING DIFFICULTY, CALF CROP PERCENTAGE, CALF MORTALITY, BIRTH WEIGHT,
WEANING WEIGHT AND WEANING WEIGHT RATIO OF CALVES FROM 2-YEAR-OLD COWS[a]
CYCLE III, PHASE 2 - COWS BORN 1975-76

Breed of Cow		No.	Type of Parturition, %				Calf Crop, %[c]		Calf Mortality, %[d]		Calf Wt, lb[e]		
Sire	Dam	Calves Born	No. Diff.[b]	Calf-Puller	C-Section	Abn. Presentation	Born	Weaned	Early	Late	Birth	200-Day	200-Day Wt Ratio[f]
Angus	Hereford	21	60.7	30.9	1.5	7.0	67.1	66.8	1.2	0.0	75.0	398	101.0
Hereford	Angus	60	34.8	50.7	11.4	3.1	83.8	70.8	14.2	1.4	74.1	389	98.7
	Average	81	47.8	40.8	6.4	5.0	75.5	68.8	7.7	0.4	74.6	394	100.0
Pinzgauer	Hereford	40	40.2	47.1	3.1	9.6	90.3	74.8	10.6	4.0	83.4	436	110.7
	Angus	58	52.7	39.6	3.9	3.8	80.0	74.0	4.8	0.8	78.9	425	107.9
	Average	98	46.5	43.3	3.5	6.7	85.1	74.4	7.7	2.4	81.1	431	109.4
Tarentaise	Hereford	31	53.9	39.3	0.0	6.9	94.0	84.8	9.9	0.0	79.8	456	115.7
	Angus	40	58.5	35.3	4.6	1.7	77.0	64.3	16.4	0.0	74.8	437	110.9
	Average	71	56.2	37.3	2.3	4.3	85.5	74.6	13.2	0.0	77.3	446	113.2
Brahman	Hereford	35	86.9	7.7	0.4	5.0	83.5	76.9	8.2	0.8	77.1	483	122.6
	Angus	55	87.1	11.0	2.7	0.0	89.5	80.7	6.7	2.4	75.4	490	124.4
	Average	90	87.0	9.4	1.5	2.1	86.5	78.8	7.4	1.6	76.2	486	123.4
Sahiwal	Hereford	30	89.3	10.4	0.4	0.0	93.6	90.2	3.9	0.0	68.5	453	115.0
	Angus	51	88.3	8.4	0.0	3.2	93.1	85.9	5.9	1.5	64.3	439	111.4
	Average	81	88.8	9.4	0.2	1.6	93.4	88.0	4.9	0.7	66.4	446	113.2
Average	Hereford	157	66.2	27.1	1.1	5.7	85.7	78.7	6.8	0.8	76.8	445	112.9
All Sire	Angus	264	64.3	29.0	4.5	2.2	84.7	75.1	9.6	1.2	73.5	436	110.7
Breeds	Average	421	65.2	28.0	2.8	3.9	85.2	76.9	8.2	1.0	75.1	441	111.9

[a] Calves from these cows were sired by Red Poll bulls.

[b] No assistance or minor hand assistance.

[c] Of cows alive at calving; cows removed from experiment only for serious injury, by death or being open two consecutive seasons.

[d] Early mortality is within 72 hr of birth; late is from 72 hr after birth until weaning.

[e] Adjusted to a steer basis. Least-squares adjustment factors for heifers were 4.1 lbs for birth weight and 28 lbs for 200-day weight.

[f] Ratio computed relative to 394 lb average for Hereford and Angus sired dams.

TABLE 8. ROMAN L. HRUSKA U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM
CALVING DATE, REBREEDING PERFORMANCE AND SIZE OF COWS CALVING AS 2-YEAR-OLD COWS
CYCLE III, PHASE 2 - COWS BORN 1975-76

Breed of Cow		No. Calving as 2-Year-Olds	Avg. Calving Date[a]	Percent Preg.[a,b]	Cow Weight, lb 2½-Year-Olds	Hip Height, in 2½-Year-Olds
Sire	Dam					
Angus	Hereford	21	March 11	98.0	976	47.9
Hereford	Angus	60	March 15	87.8	965	47.2
	Average	81	March 13	92.9	971	47.5
Pinzgauer	Hereford	40	March 16	90.6	980	49.4
	Angus	58	March 14	90.0	964	48.5
	Average	98	March 15	90.3	972	49.0
Tarentaise	Hereford	31	March 17	87.8	974	49.4
	Angus	40	March 16	83.2	950	48.4
	Average	71	March 16	85.5	962	48.9
Brahman	Hereford	35	March 20	95.6	1013	51.3
	Angus	55	March 16	93.3	1012	51.0
	Average	90	March 18	94.4	1012	51.1
Sahiwal	Hereford	30	March 17	96.9	915	49.8
	Angus	51	March 18	100.0	875	48.6
	Average	81	March 17	98.6	895	49.2
Average	Hereford	157	March 16	93.8	971	49.6
All Sire	Angus	264	March 16	90.9	953	48.7
Breeds	Average	421	March 16	92.3	962	49.1

[a] Includes cows calving at 2 and 3 years of age.

[b] Breeding period was 63 days by natural service to 7/8 Simmental bulls. Percent pregnant = no. palpated as pregnant ÷ no. palpated, and only includes cows that calved prior to breeding.

TABLE 9. ROMAN L. HRUSKA U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM
CALVING DIFFICULTY, CALF CROP PERCENTAGE, CALF MORTALITY, BIRTH WEIGHT
WEANING WEIGHT AND WEANING WEIGHT RATIO OF CALVES FROM 3-YEAR-OLD COWS[a]
CYCLE III, PHASE 2 - COWS BORN 1975

Breed of Cow		No.	Type of Parturition, %				Calf Crop, %[c]		Calf Mortality, %[d]		Calf Wt, lb[e]		
Sire	Dam	Calves Born	No Diff.[b]	Calf-Puller	C-Section	Abn. Presentation	Born	Weaned	Early	Late	Birth	200-Day	200-Day Wt Ratio[f]
Angus	Hereford	21	90.0	4.7	0.0	5.3	100.0	90.5	9.8	0.1	79.8	455	103.4
Hereford	Angus	48	83.2	12.6	0.0	4.2	94.0	86.0	8.3	0.0	78.3	426	96.8
	Average	69	86.6	8.7	0.0	4.8	97.0	88.2	9.1	0.0	79.0	440	100.0
Pinzgauer	Hereford	29	78.1	19.0	0.0	3.1	90.3	80.6	7.1	6.9	87.3	482	109.5
	Angus	43	85.1	10.1	2.7	2.1	87.8	79.6	8.7	0.0	84.7	470	106.8
	Average	72	81.6	14.6	1.2	2.6	89.0	80.1	7.9	3.4	86.0	476	108.2
Tarentaise	Hereford	13	91.6	8.1	0.2	0.1	76.5	76.5	0.1	0.0	83.6	503	114.3
	Angus	16	90.7	0.0	5.4	4.8	84.2	78.9	5.0	0.0	78.1	487	110.7
	Average	29	91.2	3.6	2.8	2.4	80.3	77.7	2.5	0.0	80.9	495	112.5
Brahman	Hereford	31	100.0	0.0	0.0	0.1	96.8	90.3	3.3	3.2	75.2	515	117.0
	Angus	35	100.0	0.0	0.0	0.0	89.7	84.6	5.7	0.0	73.3	511	116.1
	Average	66	100.0	0.0	0.0	0.0	93.3	87.5	4.5	1.6	74.3	513	116.6
Sahiwal	Hereford	13	92.5	7.3	0.0	0.1	100.0	100.0	0.1	0.0	73.3	490	111.4
	Angus	19	100.0	0.0	0.0	0.0	100.0	84.2	0.0	14.5	69.2	492	111.8
	Average	32	96.5	3.5	0.0	0.0	100.0	92.1	0.0	6.9	71.2	491	111.6
Average	Hereford	107	90.5	7.8	0.0	1.7	92.7	87.6	4.1	1.9	79.8	489	111.1
All Sire	Angus	161	91.9	4.3	1.6	2.2	91.1	82.7	5.5	2.9	76.7	477	108.4
Breeds	Average	268	91.2	6.1	0.8	2.0	91.9	85.1	4.8	2.4	78.3	483	109.8

[a] Calves from these cows were sired by 7/8 Simmental bulls (appendix table 6).

[b] No assistance or minor hand assistance.

[c] Of cows alive at calving; cows removed from experiment only for serious injury, by death or being open two consecutive seasons.

[d] Early mortality is within 72 hr of birth; late is from 72 hr after birth until weaning.

[e] Adjusted to a steer basis. Least-squares adjustment factors for heifers were 2.8 lbs for birth weight and 16 lb for 200-day weight.

[f] Ratio computed relative to 440 lb average for Hereford and Angus sired dams.

TABLE 10. ROMAN L. HRUSKA U.S. MEAT ANIMAL RESEARCH CENTER GERM PLASM EVALUATION PROGRAM
CALVING DATE, REBREEDING PERFORMANCE AND SIZE OF COWS CALVING AS 3-YEAR-OLDS
CYCLE III, PHASE 2 - COWS BORN 1975

Breed of Cow		No. Calving as 3-Year-Olds	Avg. Calving Date[a]	Percent Preg.[a,b]	Cow weight, lb 3½-Year-Olds	Hip Height, in 3½-Year-Olds
Sire	Dam					
Angus	Hereford	21	April 4	95.2	1094	48.3
Hereford	Angus	48	April 8	97.9	1023	47.3
	Average	69	April 6	96.6	1059	47.8
Pinzgauer	Hereford	29	April 1	100.0	1105	50.2
	Angus	43	March 31	97.6	1070	49.5
	Average	72	April 1	98.8	1088	49.9
Tarentaise	Hereford	13	April 4	92.3	1087	49.6
	Angus	16	April 5	93.8	1069	49.3
	Average	29	April 5	93.0	1078	49.4
Brahman	Hereford	31	April 7	93.3	1093	51.8
	Angus	35	April 6	100.0	1109	51.5
	Average	66	April 6	96.7	1101	51.7
Sahiwal	Hereford	13	April 4	100.0	1030	51.1
	Angus	19	March 31	88.9	941	48.7
	Average	32	April 2	94.4	986	49.9
Average	Hereford	107	April 4	96.2	1082	50.2
All Sire	Angus	161	April 4	95.6	1043	49.3
Breeds	Average	268	April 4	95.9	1062	49.7

[a] Includes cows calving at 3 years of age.

[b] Breeding period was 63 days by natural service to 7/8 Simmental bulls. Percent pregnant = no. palpated as pregnant ÷ no. palpated, and only includes cows that calved prior to breeding.

APPENDIX

TABLE 1. MATING PLANS TO PRODUCE CYCLE I, PHASE 2 CALVES

1969, 1970, 1971 Breeding Seasons

Dam Breeds[a]	Sire Breeds: Hereford	Angus	Jersey	South Devon	Limousin	Simmental	Charolais
Hereford	X	X	X	X	X	X	X
Angus	X	X	X	X	X	X	X

[a] The cows were 1, 2, 3 and 4-year-olds in 1969; 1, 2, 3, 4 and 5-year-olds in 1970; and 2, 3, 4, 5 and 6-year-olds in 1971.

APPENDIX

TABLE 2. MATING PLANS TO PRODUCE CYCLE II, PHASE 2 CALVES

1972 and 1973 Breeding Seasons

Dam Breeds[a]	Sire Breeds: Hereford[b]	Angus[b]	Red Poll	Brown Swiss	Gelbvieh	Maine Anjou	Chianina
Hereford[c]	X	X	X	X	X	X	X
Angus[c]	X	X	X	X	X	X	X
Red Poll	X	X	X	X			
Brown Swiss	X	X	X	X			

[a] The cows were 3, 4, 5, 6 and 7-year-olds in 1972; and 3, 4, 5, 6, 7 and 8-year-olds in 1973.

[b] Sample of same Hereford and Angus sires used in Cycle I, 1969, 1970 and 1971 breeding seasons.

[c] Cows used for GPE Cycle I, 1969, 1970 and 1971 breeding seasons.

APPENDIX

TABLE 3. MATING PLANS TO PRODUCE CYCLE I, PHASE 3 CALVES

Breed Group[a]	Sire Breeds										
	First Calf Crop[b]					Second Calf Crop[c]					Subsequent Calf Crops[d]
	Here-ford	Angus[e]	Brahman	Devon	Hol-stein	Here-ford	Angus[e]	Gelb-vieh	Maine Anjou	Chia-nina	Brown Swiss
H x H		X					X				X
A x A	X					X					X
A x H			X	X	X			X	X	X	X
H x A			X	X	X			X	X	X	X
J x H		X	X	X	X		X	X	X	X	X
J x A	X		X	X	X	X		X	X	X	X
SD x H		X	X	X	X		X	X	X	X	X
SD x A	X		X	X	X	X		X	X	X	X
L x H		X	X	X	X		X	X	X	X	X
L x A	X		X	X	X	X		X	X	X	X
S x H		X	X	X	X		X	X	X	X	X
S x A	X		X	X	X	X		X	X	X	X
C x H		X	X	X	X		X	X	X	X	X
C x A	X		X	X	X	X		X	X	X	X

[a] Females of each breed group distributed equally among cells marked "X" for each calf crop.
[b] Each group of heifers bred as yearlings to produce one calf crop as 2-year-olds by these breeds.
[c] Each group of cows bred as 2-year-olds to produce one calf crop as 3-year-olds by these breeds.
[d] Each group of cows bred to produce at least two calf crops by this breed.
[e] Sample of same sired used in Cycle I, 1969-70-71 breeding seasons.

APPENDIX

TABLE 4. MATING PLANS TO PRODUCE CYCLE II, PHASE 3 CALVES

Female Breeding Groups[a]	First Calf Crop[b]				Subsequent Calf Crops[c]
	Hereford[d]	Angus[d]	Brangus	Santa Gertrudis	Simmental
Hereford		X	X	X	X
Angus	X		X	X	X
Red Poll	X	X			X
Brown Swiss	X	X			X
H x A & Recip.			X	X	X
H x R.P. & Recip.		X	X	X	X
H x B.S. & Recip.		X	X	X	X
A x R.P. & Recip.	X		X	X	X
A x B.S. & Recip.	X		X	X	X
Gelbvieh x Hereford			X	X	X
Gelbvieh x Angus	X		X	X	X
Maine Anjou x Hereford		X	X	X	X
Maine Anjou x Angus	X		X	X	X
Chianina x Hereford		X	X	X	X
Chianina x Angus	X		X	X	X

[a] Females of each breed group distributed equally among the cells marked "X" for each calf crop.

[b] Each group of heifers bred as yearlings to produce one calf crop as 2-year-olds by these breeds.

[c] Each group of cows mated to produce at least three calf crops by 3/4 or 7/8 Simmental bulls.

[d] Sample of same Hereford and Angus sires used in Cycle I, Phase , 1969, 1970 and 1971 breeding seasons.

APPENDIX

TABLE 5. MATING PLANS TO PRODUCE CYCLE III, PHASE 2 CALVES[a]

1974 and 1975 Breeding Seasons

Female Breeds[b]	Male Breeds					
	Hereford[c]	Angus[c]	Brahman	Sahiwal	Pinzgauer	Tarentaise
Hereford		X	X	X	X	X
Angus	X		X	X	X	X

[a] Approximately 256 heifers (32 of each breed group, except Tarentaise) were transferred to Brooksville, Fla. The F_1 heifers were bred naturally to Red Poll bulls for their first calf-crop and to Simmental bulls for subsequent calf-crops.

[b] Cows used for GPE Cycle I, Phase 1.

[c] Sample of same Hereford and Angus sires used in Cycle I, Phase I 1969, 1970 and 1971 breeding seasons.